Center for Aseptic Processing and Packaging Studies (CAPPS)

North Carolina State University and The University of California, Davis

A National Science Foundation Industry/ University Cooperative Research Center since 1987

Aseptic processing may reduce costs while maintaining or improving product quality and nutritive value

Center Mission and Rationale

Aseptic processing and packaging refers to the continuous procedure in which a product first passes through a heat-hold-cold process, with subsequent filling and sealing in a sterile package in a sterile environment. This technology may save energy, packaging, and distribution costs while maintaining, and even improving, product quality and nutritive value. Successful development and implementation of this technology requires knowledge of the interrelations between product components, process conditions, and the post-process environment. The Center for Aseptic Processing and Packaging Studies (CAPPS) was chartered to provide leadership and coordination for aseptic processing and packaging research and as a mechanism to align the resources and expertise of universities to meet the research needs of participating industries.

As its mission CAPPS focuses on conducting industrially relevant, fundamental research directed at developing methods and technologies for the safe production of marketable, high quality, shelf-stable aseptic products.

Research Program

CAPPS supports research that provides the knowledge to—

- Enhance safety of aseptic products
- Characterize continuous flow thermal sterilization processes
- Ensure the integrity of aseptic packaging processes.

The Center employs an interdisciplinary approach utilizing engineering, microbiology, and chemistry to meet these objectives. Engineering studies focus on properties, kinetics, process evaluation, validation, modeling, and design. The opportunities for two-phase (solid-liquid) processing present special challenges. The slowest heating point in the fastest moving particle dictates the minimum thermal treatment. Factors which influence temperature in the particle include carrier fluid flow rate and properties; particle population, properties, and size; type and rate of heat transfer; and particle/fluid residence time distributions.

CAPPS has developed new techniques to measure thermal properties of fluids and particles at high process

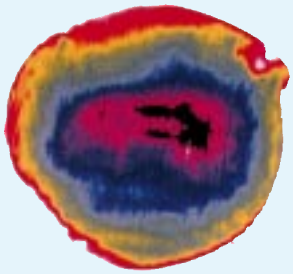
Aseptic processing and packaging is revolutionizing the food industry. This photo depicts a product to be processed, typical aseptic packages, and the coil from a heat exchanger used to process foods for packaging.

temperatures and techniques to measure residence-time distributions. Research is ongoing, using Magnetic Resonance Imaging (MRI) and other techniques, to measure the temperature history of a particle's interior as it moves through a thermal system. To meet the engineering challenge of developing rapid, non-chemical, cost-effective methods for on-line package sterilization, the center conducts research on leak detection, rapid sealing, and rapid nondestructive testing of seals.

CAPPS supports microbiology projects that aim to achieve and maintain product and package sterility and to document sterility in order to validate packaging machinery sterilization. The goal is to ensure the microbiological integrity of the finished products. Other projects include production, recovery, and documentation of the resistance of biological indicators (bacterial spores) and the mechanisms of spore inactivation.

The Center's microbiologists and engineers have collaborated on projects to develop and evaluate alternative procedures to sterilize packaging materials and equipment, to understand inactivation kinetics and mechanisms in continuous thermal processes, and to develop methodology for sterilization validation of surfaces and particulate matter.

Aseptic technology poses chemical challenges prior to and during processing. Fundamental investigations are necessary to ensure that the applied result is attractive and of high quality. CAPPS supports projects that deal with product quality considerations relating to color, texture, flavor, particulate integrity, and nutritional attributes. Reaction chemistry at high temperatures and kinetic studies to predict properties are also under



Nuclear magnetic resonance imaging (MRI) is being used to study flow rates in aseptic processing pipes.

active investigation. Additionally, nonthermal processing is of interest. Related projects range from investigations on colloidal stability of aseptic product, including shelf-life prediction studies, to enzyme stability and inactivation under high-temperature, short-time processing conditions. Interactions of packaging materials with critical quality constituents are also part of this overall effort.

Studies on physical attributes include texture, thermal characteristics of particulates, and techniques to measure the physical properties of fluids at high temperatures. CAPPS projects also deal with generic issues expected to improve the quality of aseptically processed and packaged products.

Special Center Activities

CAPPS participates in various joint research programs. The Asia Pacific Economic Cooperation (APEC) Partnership for Education links CAPPS to institutions in the Pacific Rim region. APEC activities have included cooperative research, personnel/student exchanges, education, training, and joint research projects.

Measurement of particle temperatures during aseptic processing using noninvasive temperature mapping via magnetic resonance imaging.

An aseptic pilot plant is housed in the Department of Food Science at NCSU. State-of-the-art aseptic processing and packaging equipment is installed and fully operational. Current processing units include direct heating/vacuum cooling (steam injection) and indirect heating/cooling (tubular, plate, and scraped surface heat exchangers). Paper-foil laminate aseptic packaging, shrink-wrap and boxing facilities are available. Complementary facilities at the University of California at Davis include MRI facilities for flow visualization, rheological properties and sensory analysis, and a complete line of membrane separation technologies which complement many aseptic projects. Also, an ohmic system, marlen pumps, and dewatering systems are being made available.

In addition to the facilities at NCSU and UCD, CAPPS research is conducted at many additional U.S. universities. During the past eight years, projects have been funded at Michigan State University, North Carolina A&T, Indiana University, Purdue University at Fort Wayne Campus, Rensselaer Polytechnic Institute, The Ohio State University, the University of Illinois at Urbana-Champaign, University of Rochester Medical Center, and Virginia Polytechnic Institute and State University. The scientific knowledge and laboratory facilities of these academic institutions extend and enhance the overall program of CAPPS.

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